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CORRECTING INPUT-OUTPUT COEFFICIENTS FOR CAPITAL DEPRECIATION

by

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ABSTRACT

This report presents a procedure for correcting the current account flow data of the BEA Input Output Tables for depreciation of capital goods. The theoretical reasons for this correction are presented along with a discussion of methodologies used in previous studies. Sources of capital stock and capital flow data are provided and a complete vector of lifetimes for Input-Output capital commodities has been developed. Also included is a methodology for forming a price index for capital services for the Energy Research Group 88-industry model. Finally, capital corrected energy intensities are presented for 1972 and compared with non-capital corrected energy intensities.

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1. INTRODUCTION

The energy intensities developed and estimated by the Energy Research Group at the University of Illinois are based upon data contained in the Bureau of Economic Analysis' (BEA) publication "Input Output Structure of the U.S. Economy" [3]. The data provided by BEA represent the flow of output from producing industries to consuming industries across rows and the makeup of inputs to consuming industries from producing industries down columns.

Not captured by the BEA input-output table described above are the stocks of equipment and structures, or capital, which through depreciation also represent inputs to production processes.

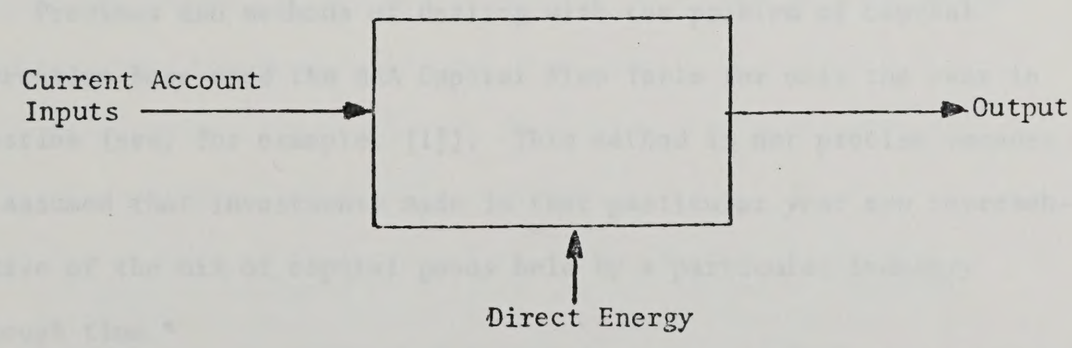
The distinction between capital and non-capital inputs is discussed in the BEA publication "Definitions and Conventions of the 1972 Input-Output Study" [2] as follows:

> *Current and capital account transactions*
>
> Current account transactions are those which are expensed within one year of purchase. Capital account transactions are those involving goods or structures which have an average useful life in excess of one year and are usually capitalized by industry. In the standard I-O table, only current account transactions are recorded within the intermediate portion of the table. Capital goods (producers' durable equipment and structures) which are produced in a given year and sold to business users are all assigned to a final demand sector, identified as gross private domestic fixed investment. Capital goods may also be exported, placed in inventories, or sold to government. Capital goods include new private structures (the product of new construction industries, production of mobile homes, and dealers' commissions) and producers' durable equipment (new and replacement purchases of both new and used equipment, used by the private sector in the production of goods and services). The standard I-O table makes no attempt to identify the industries which buy the capital goods. These transactions are recorded in a capital goods flow table, which is consistent in its industry

> classification and its row totals with the standard I-0 table but is prepared substantially independently of the standard I-0 table.
>
> It would not be advisable to include capital goods purchases in the input structure for an industry, because the relationship between capital goods purchases in a given year and that year's industry output is not likely to remain stable.
>
> BEA has produced capital flow tables for 1963 and 1967 and is currently engaged in producing a similar one for 1972 which will show the distributions of structures and equipment cross-classified by producing commodity and purchasing industry. Like the earlier tables, the 1972 capital goods flow table will be an expansion of the gross private domestic fixed investment column for 1972 in the standard I-0 table into purchasing industries. The capital goods flow table supplementary material will also show separately the distribution of the major equipment items which fall into a commodity category.

The 1972 capital goods flow table has since been completed and appears as Reference 6.

Use of current account transactions data to determine energy intensities (or the technological coefficients in the standard Leontief model) leads to underestimates of these parameters. Depreciation of capital represents a flow (of value, or embodied energy) from the depreciating capital to the output being produced. The input-output relation for some industry when capital is not included is seen below:



> classification and its row totals with the standard I-O table but is prepared substantially independently of the standard I-O table.
>
> It would not be advisable to include capital goods purchases in the input structure for an industry, because the relationship between capital goods purchases in a given year and that year's industry output is not likely to remain stable.
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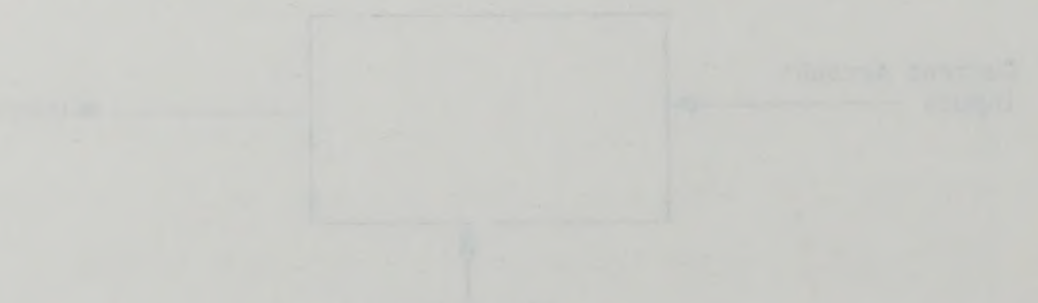
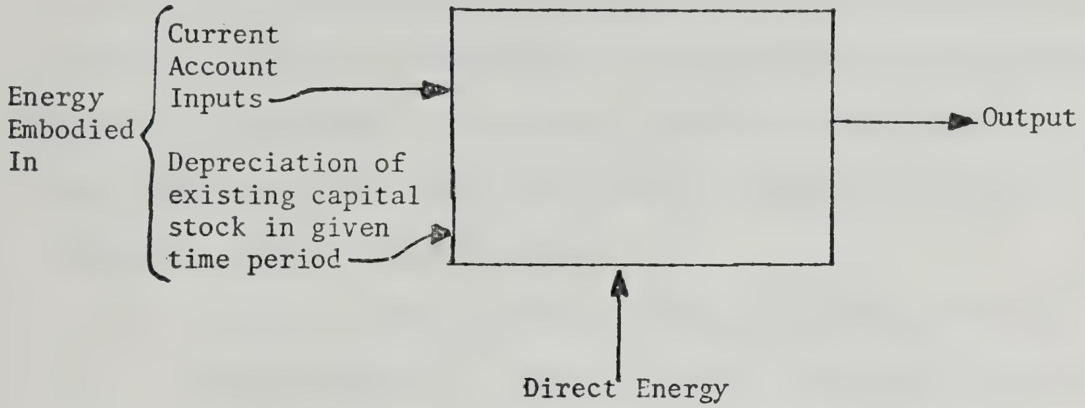
> BEA has produced capital flow tables for 1963 and 1967 and is currently engaged in producing a similar one for 1972 which will show the distribution of structures and equipment purchases by producing commodity and purchasing industry. Like the earlier tables, the 1972 capital goods flow table will be an expansion of the gross private domestic fixed investment column for 1972 in the standard I-O table into purchasing industries. The capital goods flow table supplementary material will also show separately the distribution of the major equipment items which fall into a composite category.

The 1972 capital goods flow table has since been completed and appears as Reference 6.

Use of current account transactions data to determine energy intensities for the technological coefficients of the I-O based technique would lead to underestimates of their parameters. Depreciation of capital represents a flow of value, or embodied energy, from the depreciating capital to the output being produced. The energy output related for each industry when capital is not included is seen below:



Energy intensities estimated without regard for depreciation from the existing stock of capital would be based upon the energy embodied in current account, and direct energy inputs. In actuality, the situation portrayed below holds.



That is, the true energy intensity should be calculated with the energy embodied in the current account inputs, direct energy, and the energy embodied in the capital stock which has depreciated or "flowed" into the output produced in the given time period included. It is the purpose of this work to develop and apply a methodology which will account for this capital input into the production process.

2. A PROCEDURE FOR ESTIMATING CAPITAL FLOWS

2.0 Background

Previous ERG methods of dealing with the problem of capital correction have used the BEA Capital Flow Table for only the year in question (see, for example, [1]). This method is not precise because it assumed that investments made in that particular year are representative of the mix of capital goods held by a particular industry through time.*

---

* Kirkpatrick's study [1] tests to determine if investment is "exceptional" and then proportions new investment from the 1963 BEA Capital Flows Matrix into maintenance (depreciation) and growth. The maintenance portion is then added to the corresponding entry in the current account interindustry flow matrix, thus correcting for depreciation capital flows.

In general, it cannot be correctly assumed that investment in equipment and structures by an industry at any given time will reflect the make up of the existing capital stock of that industry. For example, infrequent purchases of structures and equipment with long lives may be omitted in the year under consideration. Inclusion of such purchases in a given year would cause problems also since too much of that type capital is purchased. In addition, supply and demand conditions in both output and input markets may affect investment schedules for industries with the implication that:

1. Even if a year is normal in terms of the mix of capital goods purchased, a lesser or greater quantity of capital purchases than normal could result in adjustments to current account data which are too small or too large.
2. Certain types of capital may be preferred in that year so that adjustments to the current account data are larger for preferred capital types.

The problem at hand is to somehow determine the mix of capital goods comprising stock held by industries at any given time. Then, if this mix is known along with depreciation rates for the various types of capital comprising the capital stock, it is possible to depreciate the components of the capital stock and make the proper adjustment to the current account flow data.

Measurement of depreciation for any capital good poses a special problem as noted by Usher [NBER; p. 6]

> The problem of depreciation is to decide what proportion of capital produced in a given year is deemed to be still available *t* years later. There are four elements to consider: (1) Part of the capital stock has been

> *retired*; it is out of the capital stock entirely. (2) Some of the remaining capital stock may have deteriorated; its marginal product in a physical sense is less than when it was new, or it requires more maintenance and repair. (3) The capital stock is *older*; it has fewer years of service left than when it was new. (4) It has become *obsolete*; its marginal value product is less than when it was new because of changing tastes the availability of more efficient capital goods, or increases in the rents of cooperating factors of production.

The viewpoint taken in the construction of depreciation measures in the National Income and Product Accounts (NIPA) is that "depreciation represents the quantity of capital, as measured by its cost, that is expended in production." [NBER; p. 33]. According to Allan Young, Deputy Director of the Bureau of Economic Analysis (BEA) and John Mugrove, also with BEA, with available information the depreciation curve corresponding to the above viewpoint can not be determined precisely. "BEA's judgement is that straight-line depreciation provides a close approximation to the desired measure." [NBER; p. 32] As stated by Usher [NBER; p. 6], under straight-line depreciation "if a piece of capital lasts *t* years and is counted as one unit of capital when new, it should be counted as $\frac{(T-t)}{T}$ units of capital when it is *t* years old, for all $t \leq T$."

In addition, this assumption has been utilized in other economic studies since alternative methods of determining capital flows are highly complex or are based on other restrictive assumptions. In a study requiring data on capital flows, Berndt and Christensen [10] note:

> It is assumed in this study that the quantity of capital services rendered by each type of tangible asset is proportional to the stock of the asset. A body of literature exists which suggests that this assumption is not correct: Because capital utilization rates differ over time, service

> flows are not always proportional to stocks. Adjusting capital stocks for utilization, however, involves a strong assumption namely that all capital goods are utilized (or remain unutilized) in the same proportion. To investigate substitutability between capital types and then to arbitrarily assume fixed proportions in utilization rates is logically inconsistent. One could use a relative utilization of electric power as an index for equipment and some (yet to be constructed) space utilization index for structures, but there is no *a priori* reason to assume that all capital goods within these types are utilized in the same proportion. Furthermore, utilization rates should be viewed as choice rather than exogenous variables. Hence, even if there existed an unambiguous series of figures on utilization rates for equipment and structures, consistent estimation would require specification and estimation of an econometric model in which the optimal stocks of E and S, the optimal time path of investment in E and S, and the optimal utilization rates for E and S are all simultaneously determined. Such an extensive theoretical effort is beyond the scope of this paper. The conventional assumption of capital services being proportional to capital stocks is therefore retained.

Given these considerations straight-line depreciation will be used in this study.

2.1 Determination of the Mix of Capital Stock

While it is probably true that the investment data for an industry in any given year do not reflect the makeup of the capital stock of that industry, investment data through time will reflect the industry - capital stock mix. This is easily seen. First define

S_{ij} = the stock of the i^{th} capital good held in the j^{th} industry in the time period under consideration, $i = 1, \ldots, k$; $j = 1, \ldots, n$

L_i = the useful lifetime of a unit of the i^{th} type of capital good, $i = 1, \ldots, k$

$I_{ij\ell}$ = the quantity of the i^{th} type of capital good purchased by the j^{th} industry in period ℓ, $i = 1, \ldots, k$; $j = 1, \ldots, n$; $\ell = 1, \ldots, t$

S_j = the value of the total capital stock held by industry j, j = 1, . . .,n at some time t

$t_{ij\ell}$ = the age in years of the i^{th} type of capital good purchased by the j^{th} industry in period ℓ where

$$\max t_{ij\ell} = L_i$$

All capital is assumed to depreciate at a constand rate. It follows that

(2.1.1)
$$\frac{L_i - t_{ij\ell}}{L_i} I_{ij\ell}$$

represents the fraction of the i^{th} capital good purchased in period ℓ by industry j which has not depreciated. Therefore

(2.1.2)
$$S_{ij} = \sum_{\ell=0}^{L_i} \frac{L_i - t_{ij\ell}}{L_i} I_{ij\ell}$$

represents the total stock of the i^{th} type of capital held by the j^{th} firm. Estimation of capital stocks in this manner is known as perpetual inventory estimation.*

Unfortunately detailed time series data on investment by input-output industries only exists for the BEA input-output years 1963, 1967, and 1972. An alternative approach to that described above is to assume that the average makeup of investment by a particular industry is representative of the capital stock held by that industry. For example, if over a long time an average of twenty percent of total investment by a particular industry is comprised of Fabricated Metal Products then under this assumption it would be true that twenty percent of the firm's capital stock is comprised of Fabricated Metal

---

* See Usher [NBER, 1980; p. 5]

Products. In general, if γ_{ij} represents the fraction of average investment by firm j comprised of capital good i, and if S_{ij} represents the total value of the capital stock held by industry j at some time, then at that time

(2.1.3)
$$S_{ij} = \gamma_{ij} S_j$$

The assumption utilized to define γ_{ij} in this way is based upon the assumed equality of the average investment ratio in the i^{th} type of capital by firm j and the ratio of the stock of capital good i held by industry j, S_{ij}, to the total stock of capital held by firm j, S_j. In the long run, and given aggregated investment data this assumption is plausible. Notationally the assumption used to determine γ_{ij} is based on the equality

(2.1.4)
$$\frac{1}{m} \sum_{\ell=1}^{m} \frac{I_{ij\ell}}{\sum_{i=1}^{k} I_{ij\ell}} = \frac{S_{ij}}{S_j}$$

where k is the number of different types of capital comprising the capital stock, and m is the number of periods for which data are available. Note that for any period ℓ

(2.1.5)
$$\frac{I_{ij\ell}}{\sum_{i=1}^{k} I_{ij\ell}}$$

represents the fraction of total investment comprised of capital commodity i. It follows that

(2.1.6)

$$\frac{1}{m} \sum_{\ell=1}^{m} \frac{I_{ij\ell}}{\sum_{i=1}^{k} I_{ij\ell}}$$

represents the average of fractions of total investment comprised of capital commodity i through time for industry j. Hence γ_{ij}, the fraction of the total capital stock comprised of capital commodity i, is defined as

(2.1.7)

$$\gamma_{ij} = \frac{1}{m} \sum_{\ell=1}^{m} \frac{I_{ij\ell}}{\sum_{i=1}^{k} I_{ij\ell}}$$

2.2 Adjustments to the Current Account Flow Data

Once the capital stock share fractions γ_{ij}; $i=1\ldots k$, $j=1,\ldots n$, are determined augmentation of entries in the current account flow data can be accomplished. For each industry j, at any time t,

(2.2.1)

$$\frac{S_{ij}}{L_i} = \frac{\gamma_{ij}}{L_i} S_j$$

represents the portion of the i^{th} type of capital which depreciates, or flows as an input, to industry j in the given time period.

Calculation of the matrix of capital corrections may be made as follows. Define

(2.2.2) $\underline{\underline{S}}$ = an n x n matrix whose ij^{th} entry is S_{ij}

I_ℓ = an n x n matrix whose ij element is $I_{ij\ell}$

$\underline{S}$ = an 1 x n vector whose j^{th} element is S_j

$\hat{S}$ = an n x n diagonalized matrix whose j^{th} diagonal entry is S_j

γ = an n x n matrix whose ij^{th} element is γ_{ij} (the Capital Shares Matrix)

e = an $1 \times n$ vector of ones

L = an $n \times n$ diagonal matrix whose ii^{th} entry on the main diagonal is L_i

The vector of total investments for all industries in period ℓ is defined as

(2.2.3)

$$eI_\ell = \left[\sum_{i=1}^{k} I_{i1\ell} \quad \sum_{i=1}^{k} I_{i2\ell} \; . \; . \; . \; \sum_{i=1}^{k} I_{in\ell} \right]$$

Diagonalizing and inverting the elements of eI_ℓ yields the matrix $(e\hat{I}_\ell)^{-1}$ whose elements correspond to the denominator of equation (2.1.5). Then for any period ℓ the matrix of investment shares is

(2.2.4)

$$I_\ell \, (e\hat{I}_\ell)^{-1} = \begin{bmatrix} \dfrac{I_{11\ell}}{\sum_{i=1}^{k} I_{i1\ell}} & \dfrac{I_{12\ell}}{\sum_{i=1}^{k} I_{i2\ell}} & \cdots & \dfrac{I_{1n\ell}}{\sum_{i=1}^{k} I_{in\ell}} \\ \vdots & & & \\ \dfrac{I_{n1\ell}}{\sum_{i=1}^{k} I_{i1\ell}} & \dfrac{I_{n2\ell}}{\sum_{i=1}^{k} I_{i2\ell}} & \cdots & \dfrac{I_{nn\ell}}{\sum I_{in\ell}} \end{bmatrix}$$

Recall that the i_j^{th} element of γ is

(2.2.5)

$$\gamma_{ij} = \frac{1}{m} \sum_{\ell=1}^{m} \frac{I_{ij\ell}}{\sum_{i=1}^{k} I_{ij\ell}}$$

Given matrix (2.2.4) it follows that the matrix of all γ_{ij}'s is

(2.2.6)

$$\gamma = \frac{1}{m} \sum_{\ell=1}^{m} I_\ell \, (e\hat{I}_\ell)^{-1}$$

The matrix of capital stocks, $\underline{\underline{S}}$, for some period t is then seen to be

(2.2.7)

$$\underline{\underline{S}} = \frac{1}{m} \sum_{\ell=1}^{m} I_\ell [e\hat{I}_\ell]^{-1} \quad \hat{S} = \gamma \hat{S}$$

Augmented to the current account data for each firm is that portion of each type of capital it employes which depreciate during the given time period. For each type of capital i and each firm j the augmented quantity is $\frac{S_{ij}}{L_i}$. It follows that the matrix of capital corrections to be augmented to the current account data can be written

$$\hat{L}^{-1}\underline{\underline{S}} = \hat{L}^{-1} \frac{1}{m} \sum_{\ell=1}^{m} I_\ell [e\hat{I}_\ell]^{-1} \quad \hat{S} = \hat{L}^{-1} \gamma \hat{S} . \qquad (2.2.8)$$

2.3 Combining the Capital Corrections and the Current Account Flow Data

2.3.0 Balancing the Capital Corrected I-O Table

The ij^{th} element of the matrix $\hat{L}^{-1}\underline{\underline{S}}$ (equation 2.2.8) represents the flow of the i^{th} capital commodity utilized by the j^{th} using industry in some year. Hence the matrix $\hat{L}^{-1}\underline{\underline{S}}$ corresponds to the U matrix of the current account transaction data.

Note that when the capital flows contained in $\hat{L}^{-1}\underline{\underline{S}}$ are added to U the row sums of U, including final demand, will yield a value of output for commodities comprised of both current and capital account transactions which is greater than the output of that commodity for the given year. So that this does not occur, and so that the row sums of U and the column sums of V will be equal, the total capital flows for any commodity contained in $\hat{L}^{-1}\underline{\underline{S}}$ are substracted from the appropriate entry in the Gross Private Domestic Fixed Investment component of Final Demand. Hence the capital commodity portion of the output any commodity can be thought of as serving two purposes. First, it goes

to replace depreciated capital. Second it is used in the production of future years output. The flows contained in $\hat{L}^{-1}\underline{\underline{S}}$ are seen to represent the depreciated capital. The investment values remaining in the Gross Private Domestic Fixed Investment Component of Final Demand correspond to capital used for production in future years.

A second problem arises in adding $\hat{L}^{-1}\underline{\underline{S}}$ and U since column sums, including value added, will now be greater than the actual industry output for the given year. A balance can be obtained by subtracting off the respective column sums of $\hat{L}^{-1}\underline{\underline{S}}$ from the Profit Type Income Component of Value Added. This component of Value Added includes capital consumption allowances. Conceptually the elements of each column of $\hat{L}^{-1}\underline{\underline{S}}$ may be thought to represent this capital consumption by type of capital commodity consumed. The divergence between the total value of capital consumption by any sector as seen in value added and the column sums of $\hat{L}^{-1}\underline{\underline{S}}$ is attributed to the fact that capital consumption allowances in value added are based on tax code allowances that measure depreciation due both to declines in useful lifetimes and declines in market value. Depreciation values in matrix $\hat{L}^{-1}\underline{\underline{S}}$ are based upon declines in useful lifetimes only.

2.3.1 Trade Margins, Transportation Costs, Finance and Insurance Charges, and Dealers Commissions

In the capital flow tables, flows from BEA sectors 65, 69, and 70 respectively represent transportation costs and wholesale and retail trade margins, and finance and insurance charges incurred as capital goods go from producers to purchasers. In addition the flow from BEA sector 71 represents dealers commission on sales of new structures. Unlike capital flows from other sectors these flows

represent payments for services provided in the year transactions take place. Since these services are provided only in the year the transaction takes place, accounting for them in the capital corrections matrix $\hat{L}^{-1}\underline{\underline{S}}$ is inappropriate. On the other hand accounting for these services in the current account flow data is appropriate since these flows represent services utilized within the year of purchase. However, only the fraction of these margins, costs, charges, and commissions which corresponds to the fraction of new capital goods allocated across the current account flow table should be included.

In the current account flow data when trade margins, transportation costs, finance and insurance charges and dealers commissions are added to the value of all other intermediate inputs, the value of intermediate inputs paid by the purchaser is obtained. For capital commodities purchased in that year, the current account flow table shows trade margins, transportation costs, finance and insurance charges and dealers commissions in the final demand sector Gross Private Domestic Fixed Investment.

In the capital flow tables these margins on capital goods are allocated to their proper sector so that column sums represent the value of all capital purchases as paid for by the purchaser.

When the capital corrections are made the margins associated with capital commodities should be allocated to the appropriate using industries. As discussed in section 2.3.0, for any value of capital commodity shown as absorbed by some sector j in the capital corrections matrix $\hat{L}^{-1}\underline{\underline{S}}$ there corresponds a deduction of that value from the final demand sector Gross Private Domestic Fixed Investment.

Note that the j^{th} column sum of the capital flow table for any year, less margins, costs, charges, and commissions, represents the value in producers dollars of investment in all types of capital goods purchased by the j^{th} industry. The j^{th} column of the matrix $\hat{L}^{-1}\underline{\underline{S}}$ represents the value of the j^{th} industries capital which has depreciated. By the assumption of section 2.3 concerning replacement capital, the ratio of the column sum of $\hat{L}^{-1}\underline{\underline{S}}$ to that of the column sum of the flow table (less margins) represents the fraction of new capital absorbed by sector j which is depreciated. This ratio will also serve as an approximation of the fraction of margins, costs, charges and commission associated with the capital flows in the capital corrections matrix. Define the matrix I_m as a matrix which will strip out the rows of those sectors not containing margin, costs, charges, and commissions in the capital flow matrix.* Define the capital flow matrix for some year t as C_t.

Note that

(2.3.1.1)
$$I_m C_t$$

yields an n x n matrix of zeros except for those rows which contain margins etc.** Similarly, the matrix product $(I-I_m)C_t$ strips the margins etc. from the matrix C_t.

If e is a (1 x n) matrix of ones then

(2.3.1.2)
$$e(I-I_m)C_t$$

---

[*] I_m is similar to an identity matrix with ones along the diagonal for rows to be left in and zeros elsewhere.

[**] These margins appear in ERG Sectors 69, 71, 72, 73, 79, 80 and 81.

represents a (1 x n) vector of column totals of the capital flow matrix C_t with margins removed. These column totals represent producers values of investment. The product

(2.3.1.3)
$$e\,\hat{L}^{-1}\underline{\underline{S}}$$

yields a 1 x n vector of column totals for the capital corrections matrix. Post multiplying the diagonalized vector (2.3.1.3.) by the inverse of the diagonalized vector (2.3.1.2.) yields the matrix of fractions of new capital absorbed by each sector which is depreciated. This matrix is called F, i.e.

(2.3.1.4)
$$F = \widehat{[e\,\hat{L}^{-1}\underline{\underline{S}}]}\;\;\widehat{[e\;(I-I_m)C_t]}^{-1}$$

From this the corrected margins account flow data are defined as

(2.3.1.5)
$$M = I_m C_t\;\widehat{[e\;L^{-1}\underline{\underline{S}}]}\;\widehat{[e\;(I-I_m)C_t]}^{-1}$$

or

$$M = I_m C_t\;F$$

2.3.2 Implementation of Capital Corrections

Given these considerations the estimation of the capital corrected epsilons is an easy matter. References [14] pg. 7 defines energy intensities as $\underline{\underline{\varepsilon}} = \underline{\underline{E}}\;\hat{\underline{q}}^{-1}\;[\underline{I} - \underline{\underline{BD}}]^{-1}$.

Definitions of these matrices are given in reference [14] pg. 5. There it is shown that $B = U\hat{g}^{-1}$.

The capital corrected U matrix can be defined as $U_c = (U+\hat{L}^{-1}\underline{\underline{S}}+M)$. Substituting U_c for U, the capital corrected energy intensities are defined as $\underline{\underline{\varepsilon}}_c = E\;\hat{q}^{-1}\;[I - B_cD]^{-1}$ where $B_c = U_c\hat{g}^{-1}$.

3. USING THE CAPITAL SHARES MATRIX TO FORM A PRICE INDEX FOR CAPITAL STOCKS AND CAPITAL SERVICES

The determination of a price index which reflects the change in value of capital services provided by the capital held by some industry with respect to some base period is considered in this section. Given the large number of industries involved in the BEA input-output tables the procedure here described is straight forward and hopefully captures enough of the relative price differences between the capital stocks held by various industries to be meaningful.

Under the assumption that capital purchased in a given year goes to replace depreciated capital and to fulfill the needs of future production, a reasonable price index corresponding to the capital stock held by some industry is a weighted average of the price indices of the components making up that industry's capital.* In section 2.2 the matrix of capital shares was defined as

$$\gamma = \frac{1}{m} \sum_{\ell=1}^{m} I_\ell \quad (e\hat{I}_\ell)^{-1}$$

where γ_{ij} represents the fraction of the capital stock of industry j comprised of capital of type i. Formation of a capital stock price index for some industry in a given year can then be achieved by weighting the industrial output deflator vector for the economy in that year by the appropriate column of γ and summing the result. (That is forming the dot product of the appropriate column from γ with the

---

* Use of industry output deflators to measure capital costs are likely to overstate the price of capital due to quality changes in capital commodities. To correct these indices requires a correction factor which, to my knowledge, does not exist at the level of disaggregation considered here. However, in principle, output deflator formulas are designed to remove quality changes from prices in forming price indices. See Engerman and Rosen [NBER, 1980; pg. 158] and Young and Musgrave [NBER, 1980, pg. 41].

industrial output deflator vector for that year).

The aggregate price index used to measure the flow of capital services will not be the same as the price index developed above which corresponds to the stock of capital held by some industry. This is true because the flow of capital services is a function of the lifetimes of the various components of the capital stock. In section 2.2 it was shown that the ijth element of $\hat{L}^{-1}S$, $\frac{S_{ij}}{L_i}$, represents the value of the stock of the ith input which is used in the production process of the jth industry in some time period. It follows that $\dfrac{\frac{S_{ij}}{L_i}}{\sum_{i=1}^{k} \frac{S_{ij}}{L_i}}$ represents the cost share of the ith capital input to the production process of sector j. The set of all cost shares can serve as weights to develop the aggregate price index of capital services in the same manner as the weights used to develop an aggregate price index of the industry's capital stock.

These weights will be constant for each year since

$$\frac{S_{ij}/L_i}{\sum_{i=1}^{k} \frac{S_{ij}}{L_i}} = \frac{\gamma_{ij}\, S_j/L_i}{\sum_{i=1}^{k} \frac{\gamma_{ij}\, S_j}{L_i}} = \frac{\gamma_{ij}/L_i}{\sum_{i=1}^{k} \frac{\gamma_{ij}}{L_i}}$$

The matrix of weights to be used in forming the price index of capital services is

$$W = \hat{L}^{-1}\gamma\ \widehat{(e\hat{L}^{-1}\gamma)}^{-1}$$

where definitions (2.2.2) are utilized. Hence if $\underline{P}$ is a 1 x n vector of industrial output deflators for some year then

$$\underline{P}\ W$$

is the 1 x n vector of price indices corresponding to the capital services provided by the capital stocks of the n industries of the economy for that year.

Finally, the value of the total stock of capital consumed in any given year by an industry given its total stock of capital in that year can be determined using the equation

$$D_j = S_j \sum_{i=1}^{k} \frac{\gamma_{ij}}{L_i}$$

where D_j represents the total capital consumed by industry j. This is true since

$$D_j = \sum_{i=1}^{k} \frac{S_{ij}}{L_i}$$

But $S_{ij} = \gamma_{ij}\ S_j$ hence

$$D_j = \sum_{i=1}^{k} \frac{\gamma_{ij}}{L_i} S_j = S_j \sum_{i=1}^{k} \frac{\gamma_{ij}}{L_i}$$

For all industries these values can be found in the year in question using the equation*

$$\underline{D} = \underline{S}\ (e\hat{L}^{-1}\gamma)$$

4. DATA

4.0 The BEA Capital Flow Tables

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* See definitions (2.2.2)

The investment data needed to form the yearly investment matrices utilized in section 2.3 are found in the BEA Capital Flow Tables which are constructed for input-output years. At present, three capital flow tables exist corresponding to the years 1963, 1967, and 1972.

Capital flow data exists at two levels of aggregation for these years. Sources [5] and [6] contain flow information for over 100 types of equipment and structures to approximately 76 using industries.*

In sources [8] and [9] capital commodities are aggregated into 39 and 43 commodity groups for the years 1963 and 1967, and 1972, respectively. A listing of these commodity groupings and the differences between years is contained in Appendix I.

Although capital flow tables are highly disaggregated with respect to the type of capital commodities flowing to particular industries, the level of disaggregation for absorbing industries is fixed at about 76, corresponding to the BEA 85 order data since some industries absorb no capital. Conversations with Paula Young** and descriptions of data availability in sources [5], [6], [7], and [8] confirm this. Hence capital corrections may be made only at the 85 order level which is equivalent to the 88 sector ERG model.

4.1 Description of Data

As with current account transactions the elements of the capital flow table are in producers' prices. That is, transportation costs

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[*] For 1963, 1967 and 1972, the number of capital commodities are 117, 140 and 150 respectively. The number of absorbing sectors for those years are 76, 76, and 77. The difference in the number of capital absorbing industries is due to the separation of Restaurants and Eating Places from Wholesale and Retail Trade in the 1972 study. Also, in 1972, New Construction and Maintenance and Repair Construction are aggregated into one absorbing industry. Sector 74 in 1963 and 1972 contains no data.

[**] Inter-Industry Economics Division, Bureau of Economic Analysis.

and trade margins involved in getting the commodity from the producing to the using industry are not included in the prices used to determine values.

As noted in the 1972 report "New Structures and Equipment by Using Industries, 1972: Detailed Estimates and Methodology" (pg. 1), the capital flow tables show the indsutries acquiring the capital commodities for their own use. This is true for the years 1963 and 1967 also, although current account data for those years was presented in an industry-industry form.* Hence the data contained in the capital flow tables corresponds in nature with the definition of the current account U matrix in that the commodities absorbed by industries are shown. Of course, for the capital flow table the commodities in question are capital goods.**

The capital flow tables expand the information contained in the final demand sector Gross Private Fixed Investment. As shown in the chart below, the capital flow tables disaggregate the purchases by investors to show flows of new Capital goods to using industries.

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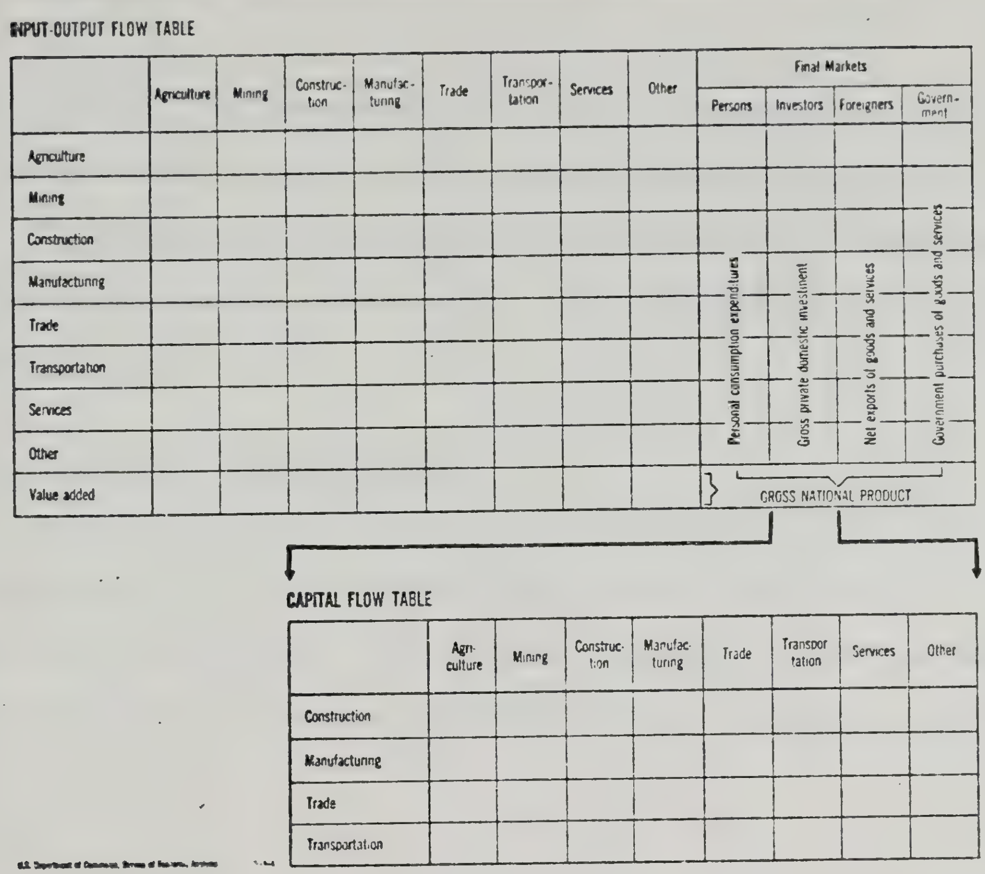
*See "Interindustry Transactions in New Structures and Equipment, 1967," pg. 9.

**Exceptions are BEA sector 65, 69, 70, and 71. Flows from these sectors to consuming sectors represent margins and commissions. See Appendix I and section 2.3.1 for a complete discussion.

CHART 4



4.2 Compatability of Data Between Input-Output Years

Several accounting changes have occured in the development of the 1972 BEA Capital Flow Table. These changes are discussed in detail in Appendix IV.

4.3 Capital Stock and Depreciation Data

Capital stock data for input-output industries corresponding to BEA industries absorbing capital commodities is contained in reference [9]. Capital stock data for several sectors comprising the agricultural sector and the Construction sector of the economy are aggregated and must be disaggregated to match the level of disaggregation found in the capital

flow tables. This procedure is discussed in Appendix II.* The value of capital stock for 1972 in 1972 dollars is shown in Appendix I.

Lifetimes used for depreciation for aggregated capital commodities are also contained in reference [9]. These lifetimes are shown in Appendix I.**

4.4 Industrial Output Deflators

Industrial Output Deflators are available at the required level of disaggregation on the BLS computer tape entitled "Time Series Date for Input-Output Industries" for the years 1958-1979. These deflators have been aggregated to conform to BEA definitions by the Energy Research Group.

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*Agriculture must be disaggregated into Livestock and Livestock Products, Other Agricultural Products, Foresty and Fishery Products, and Agricultural Forestry, and Fishery Services. Construction must be disaggregated into New Construction and Maintenance and Repair Construction.

**Lifetimes are also presented by Young and Musgrave [NBER, 1980; pp. 25-6]. The major source listed by Young and Musgrave for these lifteimes is the 1942 edition of Bulletin F issued by the Internal Revenue Service.

5. RESULTS AND CONCLUSIONS

Table 5.1 shows 1972 energy intensities without capital corrections. Table 5.2 contains the capital corrected energy intensities. Table 5.3 shows the percentage increase in energy intensities using the 1972 uncorrected intensities as a base. Table 5.4 contains data on the average increase in energy intensities for energy, non-energy, and all industries. Several industries showed percent changes greater than 100%. To avoid an upward bias in average percent changes, averages were recomputed leaving out percent changes greater than 100%.[1]

When extreme values are accounted for, it is seen that the average increase in nonprimary energy intensities range from 5.87 percent to 26.66 percent for energy producing industries and from 12.05 percent to 21.42 percent for non-energy producing industries. The average percentage increase in primary energy intensities is 1.32 percent for energy industries and 13.59 percent for non-energy producing industries. Assuming that the theory presented in this paper represents a valid method of correcting the current account flow data for capital depreciation, these data as well as the actual percent change in Table 5.3 suggest the importance of accounting for capital flows in the estimation of energy intensities or in any other work where the value of all inputs into the production process are important.

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[1] Such changes occurred in four industries. Large percent changes are not unreasonable for highly capital intensive industries. Three of the four industries showing percent changes greater than 100% are transportation industries which are highly capital intensive. Unfortunately, disaggregated capital flow data for the transportation industries do not exist, hence the large percent changes may also be due to an inaccurate method of disaggregation. See Appendix II, Section 1.2.

The methodology presented here provide a simple means of determining the corrections to the current account flow data (U matrix) in any year since all that is needed is the vector of capital stocks corresponding to the industries under consideration. The matrices necessary for the computation are not presented here due to their large size but are available from the author upon request.

Table 5.1

NON-CAPITAL CORRECTED ENERGY INTENSITIES

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T
    1972 EPSILONS WITHOUT CAPITAL CORRECTION
       IOCODE          SECTOR              COAL    CRUDE   REFINED   ELECTRIC    GAS   PRIMARY
   1      700   COAL MINING             1.0101    .0104     .0065      .0027   .0041   1.0227
   2      800   CRUDE PETRO, GAS         .0028   1.0556     .0056      .0016   .0065   1.0601
   3     3101   PETRO REFIN PROD         .0109   1.0622    1.0791      .0063   .0607   1.1487
   4     6801   ELECTRIC UTIL           1.5750   1.4465     .6288     1.1307   .8937   3.7714
   5     6802   GAS UTILITIES            .0046   1.0663     .0086      .0027  1.1022   1.1497
   6      100   LIVESTOCK                 7297    40296     25292       3871   14099    52381
   7      200   MISC AG PRODUCTS          8399    61468     35607       4433   21936    76170
   8      300   FOREST FISH PROD          5730    68746     59015       2288   11924    80323
   9      400   AG FOR, FISH SER          7024    39880     22946       3556   15533    51465
  10      500   IRON ORE MINING          41540    92965     26578      16569   68897   150467
  11      600   NONFERR MINING           24912    61233     28302      14668   32726    98608
  12      900   STONE CLAY MIN           20368    76335     47524       8932   31764   107007
  13     1000   CHEM MINERAL MIN         32425   226019     55591      17357  179315   284364
  14     1100   NEW CONSTRUCTION         11878    42274     27088       3585   16326    59045
  15     1200   MAINT, REP CONST          7222    45595     35209       2429   11734    57237
  16     1300   ORDNANCE                 13755    25810     10367       4886   15621    44103
  17     1400   FOOD                      9784    40200     19739       4173   20165    55019
  18     1500   TOBACCO                   4703    21584     12265       2088    8571    28851
  19     1600   FABRIC & MILLS           23090    77510     32083      10611   38703   111390
  20     1700   TEXTILE GOODS            18939    76347     31664       8469   38040   104776
  21     1800   APPAREL                  12045    42221     18565       5869   21083    60264
  22     1900   FAB TEXTILE PROD         15916    51613     22103       7170   25859    74826
  23     2000   WOOD PRODUCTS            10848    45279     24467       5173   21270    62108
  24     2100   WOOD CONTAINERS          12381    40250     19484       5121   21829    58309
  25     2200   H'HOLD FURNITURE         12931    35074     16085       4931   18256    53112
  26     2300   FURN, FIXTURES           17698    37541     14795       4925   22584    60563
  27     2400   PAPER PRODUCTS           31552   103118     48556      10620   55148   147645
  28     2500   PAPERBOARD CONT          18556    64962     30492       6967   33971    91791
  29     2600   PRINTING, PUBL            9662    34494     15965       4132   17962    48778
  30     2700   CHEM PRODUCTS            37794   250001     60320      14990  121875   308658
  31     2800   PLASTICS                 35252   171356     67472      12595   80320   223654
  32     2900   DRUGS, TOIL PREP         11030    48779     18081       4441   24342    65184
  33     3000   PAINTS                   18060   100740     38174       7092   45061   128399
  34     3102   PAVING                   23757   382488    359068       6485   48644   435897
  35     3103   ASPHALT                  14110   374118    343007       6234   52622   417005
  36     3200   RUBBER PRODUCTS          18309    66271     25825       7685   33814    92960
  37     3300   LEATHER PRODUCTS         13558    58619     25404       5042   29029    78682
  38     3400   FOOTWEAR                 10024    35737     15703       4384   17962    50510
  39     3500   GLASS PRODUCTS           14197    86070     16829       7528   70119   110519
  40     3600   STONE CLAY PROD          32623    94109     32591       8254   63173   137906
  41     3700   PRIM IR,STL MANU         94198    78017     26852      11530   51992   184128
  42     3800   PRIM NONFER MET          39188    88877     30977      21893   59181   146678
  43     3900   METAL CONTAINERS         40129    56042     21812       8291   34572   104699
  44     4000   HEATING,PLUMBING         32498    45606     17332       7265   28864    85366
  45     4100   SCREW MACH PROD          33848    42397     15709       7228   27010    83255
  46     4200   FAB METAL PROD           28347    45655     16518       7126   28890    81134
  47     4300   ENGINES,TURBINES         23119    32193     12953       5710   19841    60780
  48     4400   FARM MACHINERY           23532    32708     12026       4902   21060    61272
  49     4500   CONST, MINING EQ         23808    31442     11403       5181   20490    60362
  50     4600   MAT HANDLING EQ          21418    31538     12161       5010   19828    57971
  51     4700   METALWORKING EQ          17955    28314     10643       4989   18052    51053
  52     4800   SPEC IND MACH            17774    32914     12941       4997   19344    55711
  53     4900   GEN IND MACH             21732    32957     12367       5567   21162    60129
  54     5000   MACH SHOP PROD           18002    30721     11514       5412   19635    53914
  55     5100   OFC, COMPUT MACH         10532    23696     10575       4370   13194    38315
  56     5200   SERVICE IND MACH         19114    33487     12678       5739   20937    58144
  57     5300   ELEC IND APPARAT         17874    33767     13207       6496   20657    57631
  58     5400   H'HOLD APPLIANCE         19852    37293     13914       5884   22960    62989
  59     5500   ELEC LIGHT EQ            17226    35918     13293       5813   22175    58855
  60     5600   R-TV COMMUN EQ            9701    22752      9706       4389   13064    36488
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Table 5.1 (continued)

61	5700	ELECTRONIC COMP	12803	32281	13129	6024	18540	50652
62	5800	ELECTRICAL EQUIP	16481	37392	14133	6792	22075	60190
63	5900	MOTOR VEH & EQ	21130	33429	13157	5414	20202	59894
64	6000	AIRCRAFT & PARTS	11974	23917	10478	4986	13805	40368
65	6100	TRANSPORT EQUIP	19551	35089	15190	5380	20044	60073
66	6200	PROF SCIENT SUPP	11428	27245	11569	4556	15507	43091
67	6300	OPTICAL SUPPLIES	12441	30912	12104	3824	16257	47436
68	6400	MISC MANUFACT	14147	39292	16973	5602	21315	59199
69	6501	RAILROAD	5180	62910	57157	1735	9516	73337
70	6502	LOCAL TRANSPORT	5312	35991	29236	2711	8394	45277
71	6503	MOTOR FGT TRANSP	2175	35656	33127	1037	4631	40828
72	6504	WATER TRANSPORT	8725	158529	153290	3964	15940	180262
73	6505	AIR TRANSPORT	3607	124813	122449	1957	10890	137990
74	6506	PIPE LINE TRANSP	12754	89077	30918	8524	26114	110476
75	6507	TRANSP SERVICES	1744	8013	4988	947	3249	10839
76	6600	COMMUNICATIONS	2445	6877	4335	1509	2792	10653
77	6700	R-TV BROADCAST	5526	14778	8412	3661	6895	23411
78	6803	WATER,SANIT SER	6872	36023	23935	2823	12498	46886
79	6900	WHOLE,RETAIL TR	4931	19018	12693	3071	7111	27002
80	7000	FINANCE INSUR	3145	11834	7504	1924	4790	16886
81	7100	REAL ESTATE	1732	6765	4015	985	2944	9518
82	7200	HOTELS,PERS SER	7325	25979	14298	4004	12078	37338
83	7300	BUSINESS SERVICE	3930	15702	9040	1904	6726	21759
84	7500	AUTO REPAIR	9251	21086	9931	3243	11338	33608
85	7600	AMUSEMENTS	4406	17070	9241	2713	8078	24173
86	7700	MED, EDUC SER	5899	20920	10064	3475	11178	30221
87	7800	FED GOVT ENTERP	2716	17279	11020	1652	7087	22127
88	7900	ST,LOC GOVT ENT	6940	38824	22023	3489	16322	50283

Table 5.2

CAPITAL CORRECTED ENERGY INTENSITIES

1972 EPSILONS WITH CAPITAL CORRECTION

	IOCODE	SECTOR	COAL	CRUDE	REFINED	ELECTRIC	GAS	PRIMARY
1	700	COAL MINING	1.0115	.0127	.0075	.0031	.0054	1.0268
2	800	CRUDE PETRO, GAS	.0043	1.0591	.0075	.0020	.0082	1.0657
3	3101	PETRO REFIN PROD	.0142	1.0695	1.0828	.0073	.0643	1.1603
4	6801	ELECTRIC UTIL	1.6037	1.5102	.6600	1.1395	.9264	3.8731
5	6802	GAS UTILITIES	.0108	1.0804	.0153	.0045	1.1095	1.1720
6	100	LIVESTOCK	12661	50390	29986	5315	19588	69343
7	200	MISC AG PRODUCTS	12157	68181	38634	5398	25691	87646
8	300	FOREST FISH PROD	8464	74027	61461	3064	14800	89137
9	400	AG FOR, FISH SER	10806	46934	26156	4608	19440	63376
10	500	IRON ORE MINING	46557	103209	31561	17972	74276	167219
11	600	NONFERR MINING	30337	71179	32827	16136	38259	115490
12	900	STONE CLAY MIN	24502	83617	50759	10008	35880	119540
13	1000	CHEM MINERAL MIN	38734	237458	60726	19041	185706	303844
14	1100	NEW CONSTRUCTION	13460	45313	28476	4036	17996	64127
15	1200	MAINT, REP CONST	8608	48243	36426	2822	13185	61674
16	1300	ORDNANCE	15196	28723	11711	5322	17207	48902
17	1400	FOOD	12804	46001	22425	5011	23321	64709
18	1500	TOBACCO	6121	24268	13497	2477	10045	33355
19	1600	FABRIC & MILLS	25701	82720	34469	11366	41540	119992
20	1700	TEXTILE GOODS	21378	81254	33923	9181	40703	112859
21	1800	APPAREL	13703	45564	20102	6357	22897	65766
22	1900	FAB TEXTILE PROD	17953	55703	23984	7766	28080	81567
23	2000	WOOD PRODUCTS	13011	49527	26426	5795	23580	69160
24	2100	WOOD CONTAINERS	14838	45021	21659	5828	24451	66262
25	2200	H'HOLD FURNITURE	14675	38528	17677	5440	20139	58833
26	2300	FURN, FIXTURES	19454	41049	16422	5442	24488	66358
27	2400	PAPER PRODUCTS	34653	109290	51384	11526	58515	157850
28	2500	PAPERBOARD CONT	21105	70060	32833	7715	36744	100207
29	2600	PRINTING, PUBL	11597	38480	17821	4712	20100	55296
30	2700	CHEM PRODUCTS	41672	257849	63971	16117	126104	321553
31	2800	PLASTICS	38907	178648	70820	13654	84292	235696
32	2900	DRUGS, TOIL PREP	12813	52451	19804	4974	26309	71190
33	3000	PAINTS	20487	105671	40468	7807	47717	136495
34	3102	PAVING	26585	388675	362196	7304	51774	445796
35	3103	ASPHALT	17104	380558	346209	7101	55922	427366
36	3200	RUBBER PRODUCTS	20471	70594	27811	8322	36171	100099
37	3300	LEATHER PRODUCTS	16069	63527	27676	5754	31694	86837
38	3400	FOOTWEAR	11618	38932	17181	4852	19693	55780
39	3500	GLASS PRODUCTS	16603	90937	19075	8240	72758	118525
40	3600	STONE CLAY PROD	35729	100163	35367	9145	66481	147982
41	3700	PRIM IR,STL MANU	97483	84507	29850	12489	55534	194889
42	3800	PRIM NONFER MET	42411	95297	33956	22835	62667	157292
43	3900	METAL CONTAINERS	42819	61324	24237	9084	37470	113481
44	4000	HEATING,PLUMBING	34609	49814	19282	7889	31154	92324
45	4100	SCREW MACH PROD	35966	46570	17627	7852	29297	90183
46	4200	FAB METAL PROD	30398	49721	18391	7731	31111	87871
47	4300	ENGINES,TURBINES	24991	35906	14664	6267	21874	66933
48	4400	FARM MACHINERY	25269	36154	13615	5416	22943	66979
49	4500	CONST, MINING EQ	25564	34917	12999	5703	22396	66125
50	4600	MAT HANDLING EQ	23105	34909	13720	5512	21664	63543
51	4700	METALWORKING EQ	19717	31762	12211	5511	19961	56794
52	4800	SPEC IND MACH	19443	36245	14478	5495	21163	61219
53	4900	GEN IND MACH	23551	36570	14028	6109	23142	66114
54	5000	MACH SHOP PROD	19698	34071	13049	5916	21476	59475
55	5100	OFC, COMPUT MACH	12112	26953	12086	4866	14961	43654
56	5200	SERVICE IND MACH	20752	36772	14199	6227	22725	63567
57	5300	ELEC IND APPARAT	19610	37296	14844	7025	22575	63436
58	5400	H'HOLD APPLIANCE	21626	40846	15552	6415	24899	68859
59	5500	ELEC LIGHT EQ	18895	39258	14830	6313	24000	64374
60	5600	R-TV COMMUN EQ	11168	25760	11102	4842	14695	41423

Table 5.2 (continued)

61	5700	ELECTRONIC COMP	14606	35939	14816	6575	20534	56673
62	5800	ELECTRICAL EQUIP	18156	40768	15696	7295	23911	65756
63	5900	MOTOR VEH & EQ	22912	36948	14777	5939	22129	65732
64	6000	AIRCRAFT & PARTS	13694	27421	12100	5517	15711	46131
65	6100	TRANSPORT EQUIP	21273	38567	16806	5894	21929	65800
66	6200	PROF SCIENT SUPP	12984	30401	13031	5028	17220	48284
67	6300	OPTICAL SUPPLIES	13944	33945	13507	4275	17905	52434
68	6400	MISC MANUFACT	15864	42745	18574	6112	23187	64892
69	6501	RAILROAD	9975	72162	61488	3102	14511	88787
70	6502	LOCAL TRANSPORT	8671	42662	32238	3853	12120	56410
71	6503	MOTOR FGT TRANSP	6776	44802	37448	2430	9541	55986
72	6504	WATER TRANSPORT	13903	169362	158599	5549	21581	197908
73	6505	AIR TRANSPORT	8163	134485	127156	3504	15978	153754
74	6506	PIPE LINE TRANSP	16687	98620	36048	9938	30705	125404
75	6507	TRANSP SERVICES	8998	38521	27462	3631	12546	52198
76	6600	COMMUNICATIONS	4682	12289	7042	2349	5555	19146
77	6700	R-TV BROADCAST	7544	19327	10551	4356	9320	30679
78	6803	WATER,SANIT SER	8581	40279	26239	3340	14515	53433
79	6900	WHOLE,RETAIL TR	6414	22018	14100	3505	8723	31934
80	7000	FINANCE INSUR	4670	15244	9172	2418	6551	22332
81	7100	REAL ESTATE	2121	7734	4541	1101	3401	11008
82	7200	HOTELS,PERS SER	10016	31986	17255	4811	15156	46898
83	7300	BUSINESS SERVICE	5254	18500	10357	2321	8218	26307
84	7500	AUTO REPAIR	11743	25841	12113	3952	13943	41581
85	7600	AMUSEMENTS	7521	24240	12688	3706	11806	35503
86	7700	MED, EDUC SER	8061	26127	12718	4163	13768	38331
87	7800	FED GOVT ENTERP	3239	18375	11546	1815	7665	23912
88	7900	ST,LOC GOVT ENT	7774	40515	22820	3734	17227	53062

Table 5.3

PERCENT CHANGES IN ENERGY INTENSITIES DUE TO CAPITAL CORRECTION

	IOCODE	SECTOR	COAL	CRUDE	REFINED	ELECTRIC	GAS	PRIMARY
1	700	COAL MINING	.14	22.60	16.04	12.86	32.81	.40
2	800	CRUDE PETRO, GAS	55.02	.34	34.49	26.92	26.49	.53
3	3101	PETRO REFIN PROD	29.83	.69	.35	15.04	6.02	1.01
4	6801	ELECTRIC UTIL	1.82	4.41	4.97	.77	3.66	2.70
5	6802	GAS UTILITIES	135.78	1.32	77.48	69.51	.66	1.94
6	100	LIVESTOCK	73.52	25.05	18.56	37.29	38.93	32.38
7	200	MISC AG PRODUCTS	44.75	10.92	8.50	21.77	17.12	15.07
8	300	FOREST FISH PROD	47.72	7.68	4.15	33.92	24.12	10.97
9	400	AG FOR, FISH SER	53.84	17.69	13.99	29.56	25.15	23.14
10	500	IRON ORE MINING	12.08	11.02	18.75	8.47	7.81	11.13
11	600	NONFERR MINING	21.78	16.24	15.99	10.01	16.91	17.12
12	900	STONE CLAY MIN	20.30	9.54	6.81	12.29	12.96	11.71
13	1000	CHEM MINERAL MIN	19.46	5.06	9.24	9.70	3.56	6.85
14	1100	NEW CONSTRUCTION	13.32	7.19	5.13	12.59	10.23	8.61
15	1200	MAINT, REP CONST	19.19	5.81	3.46	16.18	12.37	7.75
16	1300	ORDNANCE	10.48	11.29	12.96	8.92	10.15	10.88
17	1400	FOOD	30.86	14.43	13.61	20.08	15.65	17.61
18	1500	TOBACCO	30.15	12.43	10.05	18.61	17.20	15.61
19	1600	FABRIC & MILLS	11.31	6.72	7.44	7.12	7.33	7.72
20	1700	TEXTILE GOODS	12.88	6.43	7.13	8.41	7.00	7.71
21	1800	APPAREL	13.76	7.92	8.28	8.31	8.61	9.13
22	1900	FAB TEXTILE PROD	12.80	7.92	8.51	8.31	8.59	9.01
23	2000	WOOD PRODUCTS	19.94	9.38	8.01	12.04	10.86	11.35
24	2100	WOOD CONTAINERS	19.85	11.85	11.16	13.79	12.01	13.64
25	2200	H'HOLD FURNITURE	13.49	9.85	9.90	10.33	10.31	10.77
26	2300	FURN, FIXTURES	9.92	9.34	11.00	10.49	8.43	9.57
27	2400	PAPER PRODUCTS	9.83	5.99	5.82	8.53	6.10	6.91
28	2500	PAPERBOARD CONT	13.74	7.85	7.68	10.73	8.16	9.17
29	2600	PRINTING, PUBL	20.02	11.56	11.62	14.04	11.90	13.36
30	2700	CHEM PRODUCTS	10.26	3.14	6.05	7.52	3.47	4.18
31	2800	PLASTICS	10.37	4.26	4.96	8.41	4.94	5.39
32	2900	DRUGS, TOIL PREP	16.17	7.53	9.53	12.00	8.08	9.22
33	3000	PAINTS	13.44	4.89	6.01	10.08	5.89	6.31
34	3102	PAVING	11.91	1.62	.87	12.63	6.43	2.27
35	3103	ASPHALT	21.21	1.72	.93	13.90	6.27	2.48
36	3200	RUBBER PRODUCTS	11.81	6.52	7.69	8.29	6.97	7.68
37	3300	LEATHER PRODUCTS	18.52	8.37	8.95	14.11	9.18	10.37
38	3400	FOOTWEAR	15.90	8.94	9.41	10.68	9.64	10.43
39	3500	GLASS PRODUCTS	16.95	5.65	13.34	9.45	3.76	7.24
40	3600	STONE CLAY PROD	9.52	6.43	8.52	10.80	5.24	7.31
41	3700	PRIM IR,STL MANU	3.49	8.32	11.17	8.31	6.81	5.84
42	3800	PRIM NONFER MET	8.23	7.22	9.62	4.31	5.89	7.24
43	3900	METAL CONTAINERS	6.70	9.43	11.12	9.57	8.38	8.39
44	4000	HEATING,PLUMBING	6.49	9.23	11.25	8.59	7.93	8.15
45	4100	SCREW MACH PROD	6.26	9.84	12.20	8.63	8.47	8.32
46	4200	FAB METAL PROD	7.24	8.91	11.34	8.49	7.69	8.30
47	4300	ENGINES,TURBINES	8.10	11.53	13.21	9.76	10.24	10.12
48	4400	FARM MACHINERY	7.38	10.53	13.22	10.48	8.94	9.31
49	4500	CONST, MINING EQ	7.37	11.05	13.99	10.09	9.30	9.55
50	4600	MAT HANDLING EQ	7.88	10.69	12.82	10.04	9.26	9.61
51	4700	METALWORKING EQ	9.81	12.18	14.73	10.46	10.57	11.24
52	4800	SPEC IND MACH	9.39	10.12	11.68	9.96	9.41	9.89
53	4900	GEN IND MACH	8.37	10.96	13.43	9.74	9.35	9.95
54	5000	MACH SHOP PROD	9.43	10.91	13.33	9.32	9.38	10.31
55	5100	OFC, COMPUT MACH	15.01	13.74	14.29	11.35	13.39	13.94

Table 5.3 (continued

	IOCODE	SECTOR	COAL	CRUDE	REFINED	ELECTRIC	GAS	PRIMARY
56	5200	SERVICE IND MACH	8.57	9.81	12.00	8.51	8.54	9.33
57	5300	ELEC IND APPARAT	9.71	10.45	12.39	8.14	9.28	10.07
58	5400	H'HOLD APPLIANCE	8.94	9.53	11.77	9.02	8.45	9.32
59	5500	ELEC LIGHT EQ	9.69	9.30	11.56	8.59	8.23	9.38
60	5600	R-TV COMMUN EQ	15.13	13.22	14.38	10.33	12.48	13.53
61	5700	ELECTRONIC COMP	14.08	11.33	12.85	9.16	10.76	11.89
62	5800	ELECTRICAL EQUIP	10.17	9.03	11.06	7.41	8.32	9.25
63	5900	MOTOR VEH & EQ	8.43	10.53	12.31	9.71	9.54	9.75
64	6000	AIRCRAFT & PARTS	14.36	14.65	15.48	10.64	13.80	14.27
65	6100	TRANSPORT EQUIP	8.81	9.91	10.64	9.56	9.40	9.53
66	6200	PROF SCIENT SUPP	13.61	11.58	12.64	10.37	11.05	12.05
67	6300	OPTICAL SUPPLIES	12.08	9.81	11.60	11.81	10.14	10.53
68	6400	MISC MANUFACT	12.14	8.79	9.44	9.10	8.78	9.62
69	6501	RAILROAD	92.56	14.71	7.58	78.77	52.48	21.07
70	6502	LOCAL TRANSPORT	63.25	18.53	10.27	42.15	44.38	24.59
71	6503	MOTOR FGT TRANSP	211.54	25.65	13.04	134.31	106.03	37.13
72	6504	WATER TRANSPORT	59.35	6.83	3.46	40.00	35.39	9.79
73	6505	AIR TRANSPORT	126.31	7.75	3.84	79.00	46.72	11.42
74	6506	PIPE LINE TRANSP	30.83	10.71	16.59	16.59	17.58	13.51
75	6507	TRANSP SERVICES	416.01	380.71	450.56	283.61	286.15	381.58
76	6600	COMMUNICATIONS	91.48	78.70	62.46	55.66	98.99	79.72
77	6700	R-TV BROADCAST	36.52	30.78	25.42	18.97	35.16	31.05
78	6803	WATER,SANIT SER	24.87	11.81	9.63	18.30	16.13	13.96
79	6900	WHOLE,RETAIL TR	30.07	15.78	11.08	14.11	22.68	18.27
80	7000	FINANCE INSUR	48.50	28.81	22.23	25.68	36.78	32.25
81	7100	REAL ESTATE	22.49	14.33	13.11	11.78	15.53	15.65
82	7200	HOTELS,PERS SER	36.74	23.12	20.68	20.15	25.49	25.60
83	7300	BUSINESS SERVICE	33.70	17.82	14.57	21.94	22.18	20.90
84	7500	AUTO REPAIR	26.94	22.55	21.98	21.88	22.98	23.72
85	7600	AMUSEMENTS	70.68	42.01	37.31	36.62	46.15	46.87
86	7700	MED, EDUC SER	36.65	24.89	26.37	19.80	23.17	26.84
87	7800	FED GOVT ENTERP	19.27	6.34	4.78	9.85	8.15	8.07
88	7900	ST,LOC GOVT ENT	12.02	4.36	3.62	7.03	5.54	5.53

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Table 5.4

Average Percent Change in Energy Intensities

	Coal	Crude Oil and Natural Gas	Refined Petroleum	Electricity	Gas Utilities	Primary
Energy Industries	44.52	5.87	26.66	25.02	13.93	1.32
Non-Energy Industries	29.73	16.71	17.33	20.33	19.43	18.03
All Industries	30.57	16.09	17.86	20.59	19.12	17.08
Energy Industries less outlyers[1]	21.7[2]	5.87	26.66	25.01	13.93	1.32
Non-Energy Industries less outlyers[1]	12.42[3]	12.27[5]	12.05[5]	15.67[6]	15.07[6]	13.59[5]
All Industries less outlyers[1]	21.44[4]	11.90[5]	12.88[5]	16.21[6]	15.00[6]	12.89[5]

[1] An outlying observation is defined as a percent change greater than 100%. These observations are identified by energy intensity.

[2] Does not include the percent change for gas utilities.

[3] Does not include the percent change for gas utilities, motor freight transport, air transport, or transportation services.

[4] See notes 2 and 3.

[5] Does not include the percent change for transportation services.

[6] Does not include the percent change for motor freight transport or transportation services.

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APPENDIX I

Capital Commodities and Lifetimes

This appendix lists those input-output industries which produce capital commodities. Commodities which are not common to all input-output years are identified.

Also listed in this appendix are lifetimes of various capital commodities. These lifetimes are taken from Reference [9], page 16, and correspond to National Income and Product Account, Producers Durable Equipment definitions. Input-output commodities which make up these NIPA definitions are given in Table C, pg. 57 of Reference [3]. Aggregate lifetimes are applied directly to I-O components. According to reference [9], pages 1 and 14, these service lifetimes are based on physical depreciation rates of given capital commodities and therefore correspond to the definition of capital lifetimes required by this study.

Where NIPA sectors are comprised of two or more I-O industries lifetimes are computed as a weighted average using output values in producers prices from Table C, page 57, Reference [3]. Residential (landlord durables) equipment lifetimes are based on I/O industry lifetimes for which data are available.

Finally, it should be noted that lifetimes for the capital output of BEA commodities 65, 69 and 70 do not exist since the capital flow values shown for these commodities represent margins, i.e., the value of transportation costs, wholesale and retail trade, and the finance and insurance margins incurred as capital goods go from producers to purchasers. (See Reference [6], page 18). Similarly,

the flow from BEA sector 71, Real Estate and Rental, represents dealers commissions on sales of new structures. Since energy intensities are based upon transactions measured in producers prices, and since these margins represent payments for services provided in a given year, the transactions from these sectors (65, 69, 70, and 71) are not utilized in making capital corrections. However, current account transactions are augmented to account for these sectors. (See section 2.3.1).

ERG	BEA	Cap. Flow Years	NIPA #	Lifetimes	Notes
2	8	x	7	10	
11	6	x	2	18	
14	11			33.23	3
16	13		14	14	
20	17		22, 24	12.34	1, 2
23	20		22	11	
25	22		24, 1	14.72	1, 2
26	23		1	15	
30	27	x	2	18	
36	32		22, 24	11.14	1, 2
41	37	x	2	18	
42	38		14	14	
43	39		2	18	
44	40		2	18	
46	42		2	18	
47	43		3	21	
48	44		4, 5, 22	13.12	1
49	45		4, 6, 7	9.06	1
50	46		10	14	
51	47		8	16	
52	48		9, 2	17.72	1
53	49		10, 7	13.96	1
54	50		12	10	1
55	51		11	8	
56	52		12	10	
57	53		13	14	

ERG	BEA	Cap. Flow Years	NIPA #	Lifetimes	Notes
58	54		15, 24	14	1, 2
59	55		15	14	
60	56		14, 24	13.99	1, 2
61	57		14	14	
62	58		15	14	
63	59		16, 17	6.8	1
64	60		18	9	
65	61		19, 20, 22	22.68	1
66	62		18, 21	10.8	1
67	63		21	11	
68	64		22	11	
69	6501				4
71	6503				4
72	6504				4
73	6505				4
76	66		14	14	
79	69				4
80	70	o			4
81	71				4
82	72	x	12	10	

o = 1963, 67 only

x = 1972 only

NOTES

1 - When more than one NIPA sector is involved, figures are based on weights developed from reference [3], Table C, page 57, and lifetimes which appear in Reference [9], Table 3, page 16.

2 - Lifetimes for Residential (landlord durables) are developed using available lifetimes of components making up that sector using dollar values as weights.

3 - The weights used to develop the lifetime for the output of sector 11, New Construction, are based upon 1972 output of structures found in Reference [6].

4 - Transactions from this sector to using sectors represent margins from producers to purchasers value. Energy intensities are based upon purchasers values hence transactions from this sector are not entirely included in the capital correction. See section 2.3.1.

APPENDIX II

Disaggregation of Aggregated Industries

1. COLUMN DISAGGREGATION

1.1 Compatability Between BEA and ERG Definitions

For the years 1963, 1967, and 1972 there is one to one correspondance between BEA capital absorbing sectors and ERG sectors for all sectors but the following:

1. ERG splits the Petroleum Refining and Related Industries (BEA 31) into Petroleum Refining (ERG3), Paving Mixtures and Blocks (ERG 34), and Asphalt Phelts and Coatings (ERG 35).
2. ERG splits the BEA sector Electricity, Gas, Water, and Sanitary Services (BEA 68) into the sectors Electric Utilities (ERG 4), Gas Utilities (ERG 5), and Water and Sanitary Services (ERG 78).
3. ERG splits BEA sector Transportation and Warehousing into the sectors Railroad Transport (ERG 69), Local Transport (ERG 70), Motor Freight Transport (ERG 71), Water Transport (ERG 72), Air Transport (ERG 73), Pipe Line Transport (ERG 74), and Transportation Services (ERG 75).
4. There are no flows of capital to the sectors Federal Government Industries (ERG 87), and State and Local Government Enterprises (ERG 88).

In the 1963 and 1967 capital flow tables, BEA lists 76 absorbing industries [See reference 5]. The absorbing sectors are numbered to 77 but BEA sector 74 for 1963 and 1967 is Research and Development. This sectors inputs are properly allocated to the industries actually involved in research and development. For 1963 and 1967 the discrepency between BEA and ERG colum sectorization consists of those listed above.

For 1972 the correspondence between BEA and ERG sectorization contains the same problems as for the 1963 and 1967 flow tables. In addition BEA sectors New Construction (BEA 11) and Maintenance and Repair Construction (BEA 12) have been aggregated column wise. Also, in 1972 BEA sector 74 is Eating and Drinking Places. At the 88 level of disaggregation this sector must be aggregated into BEA sector 69, Wholesale and Retail Trade.

1.2 A Procedure to Disaggregate Columns

For aggregated columns capital flows are determined by first assuming that demand for capital inputs are proportional to the demand for current account inputs. For example, suppose that of the current account inputs to the aggregated sector Petroleum Refining and Related Industries, from the sector Engines and Turbines, fifty percent went to Petroleum Refining, thirty eight percent went to Paving Mixtures and Blocks, and twelve percent went to Asphalt Phelts and Coatings. These same factors of proportionality would then be utilized to determine the capital flows from the sector Engines and Turbines to the disaggregated components of the sector Petroleum Refining and Related Products.

This procedure will be utilized for all ERG sectors which must be disaggregated from BEA sectors. Each capital flow matrix I_ℓ must undergo this procedure before the calculations discussed in section 2.2 can be undertaken. If

$$I_{\cdot j\ell} = \begin{bmatrix} I_{1j\ell} \\ I_{2j\ell} \\ \cdot \\ \cdot \\ \cdot \\ I_{nj\ell} \end{bmatrix}$$

represents the j^th^ aggregated column from matrix I_ℓ it can be disaggregated using the following procedure. Suppose that this BEA column must be disaggregated into p ERG columns in order to be compatable with ERG sectorization. From the use matrix of the appropriate year let

$$U_j = \begin{bmatrix} U_{11} & U_{12} & \cdots & U_{1t} & \cdots & U_{1p} \\ U_{21} & U_{22} & \cdots & U_{2t} & \cdots & U_{2p} \\ \vdots & \vdots & & \vdots & & \vdots \\ U_{i1} & U_{i2} & \cdots & U_{it} & \cdots & U_{ip} \\ U_{n1} & U_{n2} & \cdots & U_{nt} & \cdots & U_{np} \end{bmatrix}$$

represent the current account flows to the p sectors which form the BEA aggregate. The subscripts i and t of U_{it} are arbitrarily set equal to the row and column location of elements within the sub matrix U_j. The proportion of each commodity i to the disaggregated sector 1...,p

are simply

$$P_{it} = \frac{U_{it}}{\sum_{t=1}^{p} U_{it}} .$$

In terms of U_j a matrix of proportions is defined as

$$P = (\widehat{U_j e^T})^{-1} U_j$$

where e = a (1 x n) vector of ones and $(\widehat{U_j e^T})$ is a diagonalized matrix formed by diagonalizing the vector $(U_j e^T)$.

Given the matrix P the column vector $I_{\cdot j\ell}$ can be disaggregated into the desired ERG subvector using element by element multiplication with each column of P. Or, diagonalizing the elements of $I_{\cdot j}$ the matrix of ERG subectors is defined as

$$I_j = \widehat{I_{\cdot j}} P$$

Once this procedure is completed, the disaggregated columns are placed in the proper location in the capital flow matrix.

2.1 Row Disaggregation

For the years 1963, 1967, and 1972 the only aggregated BEA sector which appears on a row of the capital flow matrix is BEA sector 65, (Transportation and Warehousing). A procedure for disaggregating this sector is not necessary for two reasons. First disaggregated data for this sector appears in reference [5] and [6], hence data could be directly added to the proper sectors. Second, flows from this sector represent transportation margins as discussed in Appendix I and therefore should not be included in the capital correction procedure only as discussed in section 2.3.1.

APPENDIX III.

CAPITAL STOCK DATA 1963, 1967, 1972

ERG #	BEA #	SECTOR	1963	1967	1972
1	700	COAL MINING	4113.000	5648.000	7645.000
2	800	CRUDE PETRO, GAS	70193.000	76055.000	76500.000
3	3101	PETRO REFIN PRCD	17821.255	18812.168	21379.000
4	6801	ELECTRIC UTIL	64102.480	76765.392	108987.000
5	6802	GAS UTILITIES	46967.394	54811.653	80032.000
6	100	LIVESTOCK	41555.131	48234.210	59279.000
7	200	MISC AG PRODUCTS	42461.483	44931.274	47979.000
8	300	FOREST FISH PROD	2726.841	3062.065	2699.000
9	400	AG FOR, FISH SER	2759.545	4203.451	4881.000
10	500	IRON ORE MINING	1838.000	2538.000	4120.000
11	600	NONFERR MINING	3293.000	4376.000	5714.000
12	900	STONE CLAY MIN	2131.000	2968.000	4196.000
13	1000	CHEM MINERAL MIN	804.000	1397.000	1624.000
14	1100	NEW CONSTRUCTION	12966.800	15871.240	19057.000
15	1200	MAINT, REP CONST	3873.200	4740.760	5344.000
16	1300	ORDNANCE	1726.000	2153.000	2523.000
17	1400	FOOD	25123.000	27905.000	32009.000
18	1500	TOBACCO	973.000	1115.000	1288.000
19	1600	FABRIC & MILLS	6575.000	7545.000	8251.000
20	1700	TEXTILE GOODS	1361.000	1561.000	2084.000
21	1800	APPAREL	3012.000	3597.000	5226.000
22	1900	FAB TEXTILE PROD	598.000	723.000	1051.000
23	2000	WOOD PRODUCTS	6960.000	7898.000	9432.000
24	2100	WOOD CONTAINERS	512.000	412.000	305.000
25	2200	H'HOLD FURNITURE	1270.000	1569.000	2003.000
26	2300	FURN, FIXTURES	763.000	928.000	1164.000
27	2400	PAPER PRODUCTS	12483.000	15960.000	18518.000
28	2500	PAPERBOARD CONT	2772.000	3461.000	4048.000
29	2600	PRINTING, PUBL	11708.000	14320.000	17207.000
30	2700	CHEM PRODUCTS	17604.000	22531.000	26860.000
31	2800	PLASTICS	5885.000	8511.000	10762.000
32	2900	DRUGS, TOIL PREP	4082.000	4795.000	6389.000
33	3000	PAINTS	829.000	988.000	1203.000
34	3102	PAVING	391.881	432.916	659.000
35	3103	ASPHALT	447.864	432.916	682.000
36	3200	RUBBER PRODUCTS	5429.000	7292.000	10406.000
37	3300	LEATHER PRODUCTS	233.000	245.000	264.000
38	3400	FOOTWEAR	771.000	798.000	889.000
39	3500	GLASS PRODUCTS	2754.000	3520.000	4296.000
40	3600	STONE CLAY PROD	9919.000	11033.000	11955.000
41	3700	PRIM IR,STL MANU	29399.000	33890.000	36668.000
42	3800	PRIM NONFER MET	8077.000	10030.000	12373.000
43	3900	METAL CONTAINERS	1362.000	1610.000	2017.000
44	4000	HEATING,PLUMBING	3519.000	4150.000	5001.000
45	4100	SCREW MACH PROD	3528.000	4195.000	4641.000
46	4200	FAB METAL PROD	4032.000	5028.000	6015.000
47	4300	ENGINES,TURBINES	1241.000	1562.000	2318.000
48	4400	FARM MACHINERY	1413.000	1658.000	1902.000
49	4500	CONST, MINING EQ	1927.000	2364.000	2952.000
50	4600	MAT HANDLING EQ	555.000	687.000	819.000

APPENDIX III (continued)

ERG #	BEA #	SECTOR	1963	1967	1972
51	4700	METALWORKING EQ	3315.000	4130.000	4551.000
52	4800	SPEC IND MACH	1648.000	2088.000	2435.000
53	4900	GEN IND MACH	2411.000	3166.000	3854.000
54	5000	MACH SHOP PROD	1150.000	1667.000	2147.000
55	5100	OFC, COMPUT MACH	1507.000	2076.000	3212.000
56	5200	SERVICE IND MACH	1278.000	1571.000	2183.000
57	5300	ELEC IND APPARAT	2917.000	3606.000	4506.000
58	5400	H'HOLD APPLIANCE	1633.000	1844.000	2163.000
59	5500	ELEC LIGHT EQ	1221.000	1574.000	2008.000
60	5600	R-TV COMMUN EQ	3169.000	4435.000	6102.000
61	5700	ELECTRONIC COMP	1819.000	3244.000	4736.000
62	5800	ELECTRICAL EQUIP	747.000	940.000	1275.000
63	5900	MOTOR VEH & EQ	11726.000	14392.000	16836.000
64	6000	AIRCRAFT & PARTS	5878.000	7616.000	8543.000
65	6100	TRANSPORT EQUIP	2362.000	2551.000	3319.000
66	6200	PROF SCIENT SUPP	1682.000	2096.000	2679.000
67	6300	OPTICAL SUPPLIES	1457.000	1979.000	2869.000
68	6400	MISC MANUFACT	1852.000	2300.000	3003.000
69	6501	RAILROAD	40708.392	37933.269	34561.000
70	6502	LOCAL TRANSPORT	14002.532	13356.894	13681.000
71	6503	MOTOR FGT TRANSP	49369.752	54433.308	69592.000
72	6504	WATER TRANSPORT	18477.568	21246.500	16711.000
73	6505	AIR TRANSPORT	16023.516	24227.659	30035.000
74	6506	PIPE LINE TRANSP	3753.256	3579.499	3694.000
75	6507	TRANSP SERVICES	2020.984	3021.520	3741.000
76	6600	COMMUNICATIONS	47573.000	63438.000	90895.000
77	6700	R-TV BROADCAST	1759.000	2932.000	3955.000
78	6803	WATER,SANIT SER	12204.126	13811.955	10263.000
79	6900	WHOLE,RETAIL TR	79464.000	103475.000	137463.000
80	7000	FINANCE INSUR	21287.000	31665.000	50649.000
81	7100	REAL ESTATE	33345.000	42565.000	56676.000
82	7200	HOTELS,PERS SER	40224.000	47817.000	54918.000
83	7300	BUSINESS SERVICE	10900.000	16252.000	24879.000
84	7500	AUTO REPAIR	7922.000	11886.000	18324.000
85	7600	AMUSEMENTS	13005.000	17312.000	22954.000
86	7700	MED, EDUC SER	87096.000	115892.000	154046.000
87	7800	FED GOVT ENTERP	0.000	0.000	0.000
88	7900	ST,LOC GOVT ENT	0.000	0.000	0.000
89	8100	BUSINESS,TRAVEL	0.000	0.000	0.000
90	8200	OFFICE SUPPLIES	0.000	0.000	0.000

APPENDIX IV

Compatibility of Data Between Years

This appendix is comprised mainly of Appendix C of Reference [6]. The procedure developed in this report makes no attempt to adjust for difference between capital flow tables of different I-O years. In general this should not bias capital correction to a great degree since changes are small (for example SIC updates and redefinitions.). The larger problem appears to be the treatment of imports in the 1963/1967 study and their treatment in 1972. However, there does not appear to be an accurate way to determine and allocate comparible imported capital goods for the years 1963 and 1967, hence no adjustment is made.

> *Comparison with 1967*
>
> The detailed CFT for 1972 differs from that published for 1967 in a number of ways. The most obvious differences are noted here and a more detailed discussion is given in appendix C. The 1972 I-O and capital flow tables are based on the *Standard Industrial Classification Manual 1972* (SIC) rather than the 1967 SIC. The 1972 CFT is published in six-digit I-O detail rather than the four-digit detail used in the 1967 study. However, it can be readily aggregated to four-digit I-O detail for more comparability with the 1967 CFT.
>
> Three new capital goods have been included in GPFCF and appear for the first time in the 1972 CFT: uranium ore (I-O 6.0200) acquired by private electric utilities (I-O 68.0100) has been capitalized; similarly conversion, enrichment, and fabrication of uranium ore for reactors under contract by I-O 27 and I-O 37 for I-O 68.0100 have been capitalized. Installation of petroleum mining equipment by the crude petroleum and natural gas mining industry (I-O 8.0000) is now capitalized. Also, installation of machinery by repair and service establishments (I-O 72.0200) is capitalized.
>
> The treatment of imports comparable to U.S. products in the 1972 I-O tables differs from earlier tables. Previously, imported finished capital goods were allocated directly to GPFCF from I-O 80 without being associated with the comparable domestic product. In the 1972 I-O tables, they have been added to the total supply of the commodity that has been allocated to GPFCF, without distinguishing the domestic or foreign origin. This has reduced the allocation on row 80.0000 to GPFCF in the 1972 CFT to very small amounts. Accordingly, one margin item that appears in the 1967 CFT, insurance on transferred imports (I-O 70.0400), is negligible in 1972 and does not appear in the new CFT.

Ref [6, p. 19]

Appendix C of Ref 6
Comparability with the 1967 Capital Flow Table

A number of changes have been introduced in the 1972 CFT that affects its comparability with the 1967 CFT. 1/ The changes relate to the 1976 benchmark revision to the NIPA's, which affected gross private domestic fixed investment (GPDFI), and to new features introduced into the 1972 CFT as a result of changes in the 1972 I-O table.

The benchmark revisions that affected the I-O allocations to GPDFI in 1972 are as follows:

1. Expenditures for access structures to solid mineral deposits, which were formerly treated as intermediate expenses, were capitalized in 1972, thus increasing the allocation from construction to GPDFI.
2. Interest costs on utility plants under construction were excluded from the value of construction-put-in-place, reducing the allocation from construction to GPDFI.
3. Statistical revisions were made to the value-put-in-place for other categories of construction.
4. The value of computers owned by manufacturers and leased to users was reduced to reflect manufacturers' costs rather than the selling price of the computer.
5. Consumers' durable equipment purchased by landlords was capitalized and, therefore, was shifted from personal consumption expenditures to producers' durable equipment.
6. Statistical revisions were made in the allocation of engines, turbines and passenger cars to capital formation.

Allocations to GPDFI from the following I-O commodity groups were affected by these revisions: 2/

		Amount of change (Millions of dollars)
I-O 11	New construction	608
17	Miscellaneous textiles and floor coverings	18
22	Household furniture	41
32	Rubber and miscellaneous plastic products	1
43	Engines and turbines	-3
51	Office, computing, and accounting machinery	-511
54	Household appliances	461
56	Radio, TV, and communication equipment	29
59	Motor vehicles	240
65	Transportation	25
69	Wholesale and retail trade	163
80A	Directly allocated imports	-49

Changes introduced into the 1972 I-O table and their effect on comparability between the 1972 capital flow table and earlier tables are as follows:

1. The 1972 I-O study is based on the 1972 SIC classification, whereas the 1967 study is based on the 1967 SIC. However, in a number of instances, the I-O classification for 1972 was adjusted so that, at the two-digit I-O level of detail, the changes in the 1972 SIC are relatively small and thus have little practical effect on comparability with the 1967 study.

1/ The revised data for the 1967 I-O study and new features introduced into the 1972 I-O table have not been incorporated into the 1967 capital flow study. Partly because of this, a constant-dollar flow table for 1967 in 1972 dollars has not been prepared for comparison with the 1972 table, as was done for 1963 in the 1967 study.

2/ See BEA Staff Paper No. 29, *Revised Input-Output Tables for the United States: 1967.*

2. There were some additional explicit redefinitions of industries introduced into the 1972 I-O table:

    a. Redefinition of rental receipts to the real estate and rental industry, I-O 71, affects only the allocation to users of new farm housing units. They are allocated to I-O 71 in 1972, whereas they were allocated to agriculture (I-O 1 and 2) in earlier tables. The capital flow treatment of other structures on a use basis rather than on an ownership basis was unchanged in 1972 and, therefore, treatment of the remaining structures was not affected by the redefinitions introduced into the 1972 use and make tables.

    b. Redefinition to the utilities industry, I-O 68, of the receipts of industries from the sale of surplus electric power and the redefinition to trade, I-O 69, of manufacturing and mining receipts from the resale at wholesale of goods produced by others were minor and felt to have little impact on investment and, therefore, were not dealt with explicitly in the adjustments to the 1972 capital flow estimates.

3. The 1972 table changes the treatment of imports. Previously, imported finished capital goods were allocated directly from foreign trade, I-O 80, to GPDFI. In 1972, if there is a comparable domestic product, the imported commodity is added to the domestic production as part of the total supply allocated to GPDFI and to using industries in the capital flow table. Therefore, while the 1967 table shows $658.0 million of imported capital goods allocated directly to GPDFI from I-O 80, the 1972 table shows only $5.0 million of noncomparable inputs allocated to GPDFI. 3/

4. Eating and drinking places were identified separately as I-O 74 in the 1972 CFT, whereas they were included in trade (I-O 69) in the 1967 CFT.

5. Due to the lack of an adequate statistical basis for providing a split between new construction and maintenance and repair construction, the construction industries (I-O 11 and 12) were combined for 1972, whereas the two industries were distinguished in the 1967 CFT.

There are some changes in methodology in constructing the 1972 CFT that could affect comparisons with the previous table. Particularly, the procedure to reconcile the initial estimates of the capital flows to using industry with estimates of total capital expenditures by using industry has been changed. (See section II-C of the main text of the article, "Reconciliation of estimates of capital flows and capital expenditures.")

3/ The tape containing the data underlying the capital flow study preserved the detail on comparable imports, even though the comparable imports were allocated to using industries in the same proportion as the domestic product.

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